

WHAT IS CLAIMED IS:

1. A semiconductor device fabrication method comprising:

forming a mask material in a surface portion of a semiconductor substrate, and forming a step having a projection by using the mask material;

forming a dielectric film on the semiconductor substrate so as to fill the step and planarize an entire surface;

annealing the dielectric film;

etching back the dielectric film such that a surface of the dielectric film is positioned between upper and lower surfaces of the mask material; and

removing the mask material to expose a surface of the projection of the semiconductor substrate.

2. A method according to claim 1, when the dielectric film is formed, the method further comprising:

overlaying the dielectric film, formed on a base film by coating, onto the surface of the semiconductor substrate having the step while heat and pressure are applied; and

transferring the dielectric film onto the surface of the semiconductor substrate by removing the base film.

3. A method according to claim 1, further comprising, etching at least a portion of the mask material so as to decrease a mask width, before the dielectric film is formed on the semiconductor substrate.

4. A method according to claim 1, wherein the dielectric film is a polysilazane film.

5. A method according to claim 1, further comprising, on a surface of the step, an insulating film having a film thickness with which the step is filled halfway, before the dielectric film is buried.

6. A method according to claim 5, wherein the insulating film is formed by CVD when the dielectric film is formed.

7. A semiconductor device fabrication method comprising:

forming island-like first and second insulating films on a semiconductor substrate;

forming a third insulating film on side surfaces of the first and second insulating films;

forming a trench in a surface portion of the semiconductor substrate by using the first, second, and third insulating films as masks;

filling the trench with a first dielectric film;

etching back the first dielectric film such that a surface of the first dielectric film is positioned between upper and bottom surfaces of the second insulating film; and

exposing the surface of the semiconductor substrate by removing portions of the first and second insulating films, which are not covered with the first dielectric film.

8. A method according to claim 7, when the first dielectric film is formed, the method further comprising:

overlaying the first dielectric film, formed on a base film by coating, onto the surface of the semiconductor substrate having the trench while heat and pressure are applied; and

transferring the dielectric film onto the surface of the semiconductor substrate having the trench by removing the base film, thereby obtaining a flat shape.

9. A method according to claim 7, wherein a minimum value of a width of the trench is smaller by an amount twice a film thickness of the third insulating film than a minimum value determined by a lithography step.

10. A method according to claim 7, wherein the first dielectric film is a polysilazane film.

11. A semiconductor device comprising:

element isolation trenches formed in a surface

portion of a semiconductor substrate so as to surround an island-like element formation area;

a first insulating film buried in said trenches from bottom surfaces of said trenches to a height lower than the surface of said semiconductor substrate; and

a second insulating film buried on said first insulating film in said trenches,

wherein said first insulating film is a polysilazane film, and said second insulating film is an HDP-SiO₂ film.

12. A semiconductor device fabrication method comprising:

forming a first insulating film on a semiconductor substrate having a step in a surface portion, thereby filling the step;

leaving the first insulating film behind on a bottom of the step by etch back;

filling the step by forming a second insulating film on a surface of the first insulating film; and

annealing the first insulating film in a water-containing ambient.

13. A method according to claim 12, when the first insulating film is formed, the method further comprising:

overlaying the first film, formed on a base film by coating, onto the surface of the semiconductor substrate having the step while heat and pressure are applied; and

transferring the first film onto the surface of the semiconductor substrate having the step by removing the base film, thereby obtaining a flat shape.

14. A method according to claim 12, when annealing is performed, the method further comprising:

holding the semiconductor substrate at a temperature of 350°C to 450°C for a predetermined time; and

holding the semiconductor substrate at a

temperature of 450°C to 800°C for a predetermined time.

15. A semiconductor device comprising:

element isolation trenches formed in a semiconductor substrate so as to surround an island-like element formation area;

a first insulating film formed in said trenches so as to cover inner walls of said trenches;

a second insulating film formed on said first insulating film in said trenches to a height lower than a surface of said semiconductor substrate; and

a third insulating film formed on said second insulating film so as to fill said trenches.

16. A device according to claim 15, wherein said first insulating film is formed by CVD, said second insulating film is formed by coating, and said third insulating film is formed by CVD.

17. A semiconductor device fabrication method comprising:

forming a first insulating film on a surface of a semiconductor substrate having a trench in a surface portion, thereby covering inner walls of the trench with the first insulating film;

selectively forming a second insulating film on the first insulating film in the trench; and

selectively forming a third insulating film on the first and second insulating films in the trench.

18. A method according to claim 17, further comprising:

annealing the semiconductor substrate in a water-containing ambient at a temperature of 350°C to 600°C for a predetermined time, after the second insulating film is formed; and

holding the semiconductor substrate at a temperature of 450°C to 1,000°C for a predetermined time.

19. A semiconductor device comprising:

a first insulating film formed on inner walls of a trench in a surface portion of a semiconductor

substrate;

a second insulating film formed on said first insulating film in said trench; and

a third insulating film formed on said first and second insulating films in said trench,

wherein an Si density of said second insulating film surrounded by said first and third insulating films is smaller than those of said first and third insulating films.

20. A semiconductor device fabrication method comprising:

forming a trench in a surface portion of a semiconductor substrate;

forming a first insulating film on inner walls of the trench;

forming a second insulating film on the first insulating film;

etching back the first and second insulating films to bury the first and second insulating films in the trench to a height lower than the surface of the semiconductor substrate; and

depositing a third insulating film on the first and second insulating films in the trench and planarizing the third insulating film, thereby burying the first, second, and third insulating film in the trench.